



Differentiated Instruction is an Unproven Fad

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About the author

Michael Zwaagstra is a public high school teacher, education researcher and author. He has extensive teaching experience at a variety of grade levels and currently teaches high school social studies in Manitoba. He received his Bachelor of Education, Post-Baccalaureate Certificate in Education and Master of Education degrees from the University of Manitoba where he won numerous academic awards including the A.W. Hogg Undergraduate Scholarship, the Klieforth Prize in American History and the Schoolmasters' Wives Association Scholarship.

As an educator, Zwaagstra is a strong proponent of raising academic standards, holding schools accountable for their results and expanding the educational options available to parents. He conducts policy research on education issues for the Frontier Centre for Public Policy and the Atlantic Institute for Market Studies. His research has addressed topics such as standardized testing, teaching methodologies, assessment, school choice and teachers' unions.

His columns promoting common-sense education reforms have been published in major daily newspapers including the *National Post*, *The Globe and Mail*, *The Province*, the *Calgary Herald*, the *Winnipeg Free Press* and *The Chronicle Herald*. At the 2013 Canadian Community Newspaper Awards, Zwaagstra received second place in the Outstanding Columnist category.

He is a frequent guest on radio and television stations across the country. His first book, *What's Wrong with Our Schools and How We Can Fix Them* (co-authored with Rodney A. Clifton and John C. Long), was published in 2010. *What's Wrong with Our Schools* ignited debate on education reform across the country in school staff rooms, newspapers and university campuses.

Zwaagstra also has experience as an elected official. In 2006, he was elected to the Steinbach City Council. He was re-elected in 2010 and appointed to the position of Deputy Mayor in 2012. His community involvement includes serving on several boards, writing a weekly column for his local paper and teaching adult classes in his church.



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Table of Contents

Title	Page
Executive Summary	4
Introduction	5
What is differentiated instruction?	6
The influence of differentiated instruction	7
Evaluating differentiated instruction	7
How differentiated instruction undermines effective teaching	13
Conclusion	15

Note to reader: Endnotes and some words in this document may appear in [blue](#) and underlined. When e-reading, these links will directly access relevant online websites or documents using your associated browser. Endnotes' numerals will directly link to the appropriate reference at the end of this document.

Executive Summary

Differentiated instruction is one of the most widespread education methodologies in North America. Faculties of education, school boards and departments of education promote its use, and dozens of how-to books have been written by differentiated instruction advocates.

Implementing differentiated instruction is a major undertaking because it represents a significant shift away from teacher-directed, whole-class instruction. Teachers who use differentiated instruction must determine how each student learns best and then adapt their instruction to meet the needs of each student. Flexible grouping arrangements, problem-based learning and learning-style inventories are the hallmarks of the differentiated classroom.

However, the claims made by differentiated instruction advocates deserve scrutiny. Differentiated instruction rests on the premise that all students have an individual learning style (visual, verbal or tactile-kinesthetic) and learn best when new concepts are introduced through their preferred style. As research has not turned up any evidence to support this theory, this premise is flawed.

In addition, research does not support constructivist teaching methodologies in differentiated instruction that relegate teachers to a “guide on the side” role. As a case in point, John Hattie of the Melbourne Education Research Institute analyzed the results of 285 research studies on problem-based learning and found that traditional instructional methods were better at helping students acquire basic knowledge. Problem-based learning, a regular feature in differentiated classrooms, was only effective when students already had the necessary background knowledge about the subject being taught.

Fortunately, there is a path to improved student achievement that does not involve a significant amount of money or a complete overhaul of the structure of public education. Author and former school administrator Mike Schmoker outlines three research-based components that form the key to effective instruction. These components are a reasonably coherent curriculum, sound lessons using direct instruction and purposeful reading and writing in every discipline.

The real harm of differentiated instruction comes from how it undermines each of these three components. Differentiated instruction downplays the importance of curriculum content, discourages teachers from making regular use of direct instruction and makes it easy for students to avoid reading challenging material if it does not match their so-called learning style. Far from being a helpful reform, differentiated instruction can be downright harmful to students’ education.

Unfortunately, the field of education has a well-deserved reputation of being too quick to adopt the latest educational fad. This needs to change. A careful examination of new initiatives such as differentiated instruction would be a good place to start. Instead of jumping wholesale into the latest fad, educators should critically examine the claims made by proponents and decide for themselves which ideas are worthy of implementation.

Introduction

Failed education fads litter the history of public education. Whole language, open-area classrooms and new math are just a few that afflicted public schools in the last century. While many of these fads were eventually rejected, their impact on schools remains substantial. A failed education fad can be costly both in terms of money and in the negative effect it has on student academic achievement.

Considering this track record, any new initiative must receive careful scrutiny before its widespread adoption by schools. Differentiated instruction is one such initiative. Because it rests on the premise that teachers must tailor their instruction to the individual learning styles of their students, differentiated instruction has had a significant impact on classroom practices across North America. Teachers who follow its principles often find themselves constructing multiple lessons for the same topic in an effort to match the content to each student's learning style. Advocates of differentiated instruction claim it is worth the effort and that students benefit from being in differentiated classrooms.

However, the widespread adoption of differentiated instruction is not, by itself, sufficient evidence for its validity. To evaluate the effectiveness of this instructional method, it is important to carefully scrutinize the claims made by its advocates. Does differentiated instruction lead to improved student achievement, or does it simply create more work for overburdened teachers? Specifically, the premises upon which differentiated instruction rests, most notably that each student has an individual learning style, need to be closely examined.

If the evidence supports differentiated instruction, then its widespread implementation is justified. However, if it turns out that the evidence for this approach is lacking, we must be prepared to reject it. There is no reason to subject students and teachers to a time-consuming instructional approach if there is no evidence that it improves student learning.

“*Teachers who follow its principles (differentiated instruction) often find themselves constructing multiple lessons for the same topic in an effort to match the content to each student's learning style.*”

What is differentiated instruction?

The most prominent advocate of differentiated instruction is Carol Ann Tomlinson, an education professor at the University of Virginia.¹ Tomlinson's numerous books and articles have been widely influential in persuading schools to adopt differentiated instruction in their classrooms. In her 1999 book, *The Differentiated Classroom: Responding to the Needs of All Learners*, Tomlinson sets out what is widely regarded as the definitive exposition of differentiated instruction:

In differentiated classrooms, teachers begin where students are, not the front of a curriculum guide. They accept and build upon the premise that learners differ in important ways. Thus, they also accept and act on the premise that teachers must be ready to engage students in instruction through different learning modalities, by appealing to differing interests, and by using varied rates of instruction along with varied degrees of complexity. In differentiated classrooms, teachers ensure that a student competes against himself as he grows and develops more than he competes against other students.²

In short, a teacher who uses differentiated instruction must determine how each student learns best (their individual learning style) and then adapt the instruction to best meet the needs of each student. The process of learning is more important than the specific content found in the curriculum guide. As a result, teachers in differentiated classrooms often deliver a series of mini-lessons to small groups of students instead of whole-class lessons. The learning groups may be based on the students' interest, individual learning style or level of readiness, but they should be flexible and change on a regular basis.³

While teachers may have various ways of implementing differentiated instruction, identifying the individual learning styles, or modalities, of students is essential for properly meeting their needs.⁴ Students are generally classified as visual, auditory, tactile-kinesthetic learners and should, in theory, receive instruction through their preferred modality.⁵ Teachers in differentiated classrooms are expected to design a variety of lessons so that students succeed regardless of their learning styles.

Advocates of differentiated instruction are quick to contrast this approach with traditional teaching in which teachers with subject-matter expertise provide whole-class lessons.⁶ Julia Roberts and Tracy Inman, education professors at Western Kentucky University, even suggest that there is no problem with students knowing more about a subject than their teacher does. "You may be the guide on the side as you learn with students rather than the sage on the stage. It's a win-win situation."⁷ Advocates of differentiated instruction are considered educational progressives rather than traditionalists.

In a short summary of the history of differentiated instruction, Joanne Yatvin, an education professor at Portland State University, highlights the writings of Jean-Jacques Rousseau, an 18th century French philosopher who believed educators should allow children to follow their own interests. She notes that Rousseau's romanticism blended nicely with John Dewey's progressivism, which in turn contributed to the rise of constructivist philosophy.⁸ Constructivism essentially means that students need to construct their own understanding in the way that works best for them. Differentiated instruction's emphasis on individual learning styles and de-emphasis on curriculum content fits well with constructivist philosophy.

The influence of differentiated instruction

Differentiated instruction has become one of the most widely promoted instructional approaches in North America.⁹ For example, the Alberta Initiative for School Improvement, which operates under the auspices of Alberta Education, makes the implementation of differentiated instruction in schools across the province one of its key goals.¹⁰ Alberta Education also provides schools with differentiated instruction guidelines and resources.¹¹

A similar emphasis on differentiated instruction can be found in Ontario.¹² The Ontario Institute for Studies in Education (OISE), which is the largest education faculty in the province, prominently features differentiated instruction on its Web page and provides links to more information about how to incorporate it in the classroom.¹³ Prospective teachers in Ontario can expect differentiated instruction to feature prominently in their training programs no matter which faculty of education they attend.

The reach of differentiated instruction even extends to the East coast. As part of its inclusive education initiative, Newfoundland and Labrador's Department of Education requires representatives from each school to receive training in differentiated instruction.¹⁴ The Eastern School District in St. John's has enthusiastically promoted differentiated instruction in its newsletters, and the division has brought in experts to help teachers implement the method in their classrooms.¹⁵

There is no question that provincial education departments, education faculties and school boards appear united in their belief that differentiated instruction is an effective teaching methodology.

Evaluating differentiated instruction

However, the widespread adoption of differentiated instruction by itself is insufficient evidence of its effectiveness. Education is plagued with failed fads that once enjoyed near universal acceptance among experts.

As a case in point, the whole language theory for the teaching of reading appeared in various iterations throughout the 20th century. Whole language is a constructivist approach to reading instruction that de-emphasizes the importance of students sounding out words (phonics) and instead encourages them to construct their own meaning by guessing what the words mean in their context. During its most recent incarnation in the 1980s, whole language swept across North America and educational administrators rushed to bring their schools in line with this progressive approach.¹⁶

Despite its widespread adoption, there was never any solid evidence for the effectiveness of whole language. Jeanne Chall of the Harvard Graduate School of Education conducted an extensive analysis of the research evidence several decades ago and found that there was no question that phonics was superior to whole language, particularly for younger

students.¹⁷ A more recent analysis by John Hattie of the Melbourne Education Research Institute came to the same conclusion.¹⁸

Clearly, it is possible for an education theory to be widely adopted even when there is little evidence that it actually works. To evaluate differentiated instruction properly, three separate issues are examined.

First, differentiated instruction rests upon the premise that each student has an individual learning style that helps him or her learn. If this is true, then there may be good reason for teachers to present the same content in different ways to different students. However, if there is no evidence for the existence of learning styles, then the foundational premise behind differentiated instruction is false.

Second, the proper implementation of differentiated instruction requires a shift to the constructivist approach to teaching. In order to have students working at different stations and in flexible grouping arrangements, teachers need to make heavy use of inquiry-based teaching techniques that encourage students to follow their areas of interest. While some whole-class instruction is permissible in a differentiated classroom, the reality is that teacher-directed instruction is minimal. Thus, a lack of evidence for constructivist methodologies would be a significant blow to differentiated instruction.

Finally, if differentiated instruction is effective, there should be an abundance of research evidence showing the positive impact its adoption has had on student achievement. In particular, teachers who make extensive use of differentiated instruction should have much better results than teachers who use methods that are more traditional.

Thus, we should be able to come to a conclusion about differentiated instruction by answering the following three questions:

- 1) Does everyone have an individual learning style?
- 2) Are constructivist approaches to teaching more effective than traditional approaches are?
- 3) Do the claims made by differentiated instruction advocates stand up to scrutiny?

Question #1

Does everyone have an individual learning style?

According to learning styles theory, people learn best when they experience new concepts through their preferred learning styles. For example, visual learners learn best when they see an image or picture, auditory learners require verbal explanations and tactile-kinesthetic learners prefer working with their hands.¹⁹ Thus, a teacher using differentiated instruction will do everything she or he can to identify each student's learning style and adapt the lessons accordingly.

Daniel Willingham, a cognitive psychologist at the University of Virginia, explains that it is relatively simple to test this theory. Take a group of people and identify each person's so-

called learning style. Then share a story with them but let only half experience it through their preferred learning style. For example, the story could be conveyed by pictures to visual learners and recited verbally to auditory learners. If the theory is correct, people who experience the story through their preferred learning style will remember the story better than those who do not.²⁰

Psychologists Laura Massa and Richard Mayer of the University of California, Santa Barbara, conducted such a study several years ago. They used a standard questionnaire to classify each student in their experiment group as a visual or auditory learner. They found virtually no difference between students who learned a new concept through their preferred learning style and those who learned it a different way.²¹ In other words, it did not matter if the instruction matched the students' preferred learning styles.

This was not the only study to come to this conclusion about learning styles. A peer-reviewed analysis of the research literature on learning styles by psychologists Harold Pashler, Mark McDaniel, Doug Rohrer and Robert Bjork concluded, "[T]here is no adequate evidence base to justify incorporating learning styles assessments into general educational practice."²² Hattie, who has reviewed thousands of research studies on student achievement, firmly dismisses the identification of learning styles as a "modern fad" and "one of the more fruitless pursuits."²³

Catherine Scott, a senior research fellow at the Australian Council for Educational Research, agrees that there is no evidence that students need to learn according to their individual learning styles. Scott argues that not only is the learning styles theory useless in the classroom, it is actually harmful because it causes teachers to label students incorrectly and prevents the teachers from using teaching methodologies that are more effective.²⁴

Clearly, the evidence does not support the learning styles theory, and this fact has significant implications for differentiated instruction. Since there is no proof that students learn best when instruction matches their preferred learning style, the premise behind differentiated instruction is unconfirmed.

However, this does not mean that teachers should teach every subject in exactly the same way. Willingham suggests that teachers need to vary their instruction based on what is best suited to the content being taught. For example, visual images are probably more effective than verbal descriptions for helping students understand Mayan pyramids.²⁵ Other topics lend themselves more naturally to verbal descriptions or hands-on projects. Sometimes looking at a picture is the best way to get a concept across while at other times it makes sense to have students construct a model.

For many topics, it is appropriate for teachers to use a variety of teaching strategies. For example, a good elementary teacher will do far more than just lecture students when it comes time to teach the solar system. Rather, the teacher will show them pictures of the planets, provide accurate verbal descriptions and give students an opportunity to work with models of the planets.

Good teachers have always used a variety of strategies, appealing to more than one sense, to engage their students.

Thus, there is no need to split students up into different learning styles groups and provide them with separate lessons. There is a huge difference between using a variety of teaching strategies and basing your instructional approach on differentiated instruction.

Question #2

Are constructivist approaches to teaching more effective than traditional approaches?

As noted earlier, the widespread adoption of differentiated instruction in schools closely correlates with the rise of the constructivist philosophy of learning.²⁶ Constructivism holds that all knowledge is socially constructed by individual learners and that teachers need to allow students to decide for themselves how best to learn new concepts. In a constructivist math class, for example, a teacher refrains from showing students the correct way to solve a question and instead allows students to invent their own problem-solving techniques.²⁷

A good differentiated classroom is one in which the teacher offers many choices to the students. Various learning centres, or stations, throughout the classroom often feature prominently, as students can select the learning activity that best matches their personal interest.²⁸ Problem-based learning, or inquiry-based learning, is also commonly used. As part of this strategy, teachers present an unclear, complex problem to students and ask them to solve it. Students must figure out what information they need and how to proceed.²⁹

While constructivist methodologies are popular in many schools, there is little evidence for their effectiveness. After reviewing thousands of research studies on factors affecting student achievement, John Hattie had the following to say about those who wish to relegate teachers to being mere “guides on the side”:

Constructivism too often is seen in terms of student-centered inquiry learning, problem-based learning, and task-based learning, and common jargon words include ‘authentic’, ‘discovery’, and ‘intrinsically motivated learning’. The role of the constructivist teacher is claimed to be more of facilitation to provide opportunities for individual students to acquire knowledge and construct meaning through their own activities, and through discussion, reflection and the sharing of ideas with other learners with minimal corrective intervention.

These kinds of statements are almost directly opposite to the successful recipe for teaching and learning³⁰ (emphasis added)

Hattie synthesized eight meta-analyses that analyzed the results of 285 research studies on the effectiveness of problem-based learning. He found that traditional instructional methods were better at helping students acquire basic knowledge. Problem-based learning was only effective when students already had the necessary background knowledge about the subject at hand.³¹ However, since most public school students, particularly those in the elementary grades, do not have the necessary background knowledge, problem-based learning is of limited value to them.

One of the largest research studies of teaching methodologies was Project Follow Through, which started in the late 1960s. It followed the academic progress of more than 72,000 students over a 10-year period at more than 180 sites. Out of all the methodologies examined, only one had a consistently positive impact on student learning—direct instruction.³² Revealingly, direct instruction is a decidedly traditional methodology; it is a whole-class, teacher-directed approach.

Other researchers have also concluded that constructivist teaching methodologies are inferior to the more traditional techniques.³³ Perplexing “new math” methods, the ineffective whole-language approach to reading, and disorganized open-area classrooms are but a few of the techniques on the long list of failed education reforms that can be laid directly at the feet of the constructivist philosophy of teaching.

The lack of research evidence for constructivist teaching methods is a significant blow to differentiated instruction.

Question #3

Do the claims made by differentiated instruction advocates stand up to scrutiny?

Advocates of differentiated instruction often make many claims about the effectiveness of their approach. The back covers of many of the most prominent books about differentiated instruction contain glowing descriptions about how it will revolutionize classroom instruction. Implementing differentiated instruction in every classroom is said to be as simple as following the 10-step process outlined in yet another book about this approach.³⁴

However, while it is possible to find individual teachers who support differentiated instruction, even many advocates acknowledge that there is actually “no empirical validation of differentiated instruction as a package ...”³⁵ Other researchers, such as Bryan Goodwin of the Mid-continent Research for Education and Learning, agree that there is a “dearth of evidence supporting differentiated instruction” and that “[t]he extent to which teachers differentiate instruction in their classrooms is not a key variable in student success.”³⁶

The most prominent proponent of differentiated instruction, Carol Ann Tomlinson, has a three-page list of articles about differentiated instruction on her professional website.³⁷ While the list contains many articles by Tomlinson and her disciples about how to implement differentiated instruction, none provides any empirical evidence of its effectiveness. In other words, the articles are useful only for those who have already been persuaded to implement differentiated instruction in their classrooms—not for those looking for hard evidence of its effectiveness.

Two schools often cited as successful examples of differentiated instruction are Conway Elementary School in Missouri and Colchester High School in Vermont. One of Tomlinson’s recent books features the process by which differentiated instruction was adopted in these schools.³⁸ Pre-differentiation and post-differentiation test scores are, among other things, cited to provide evidence of differentiated instruction’s effectiveness.

Colchester High School is described, prior to differentiation, as a school with a high dropout rate, low test scores and poor student discipline. After differentiated instruction, graduation rates increased, disciplinary interventions declined and test scores increased. The obvious conclusion for readers to draw is that differentiated instruction was responsible for this school’s dramatic turnaround.³⁹

However, there is more to this story. Colchester High School did much more over the last decade than simply implement differentiated instruction. Among other things, the school rewrote the curriculum to better correlate with state standards tests, established a more collaborative working environment for staff and provided more after-class academic support to students.⁴⁰ While differentiated instruction might have contributed to Colchester’s success, it is more likely that the other reforms were responsible.

As for Conway Elementary School, its background is different in that it was considered a successful school prior to differentiation. Thus, its improvement was less dramatic than Colchester’s was although student test scores still rose during the differentiation initiative.⁴¹ However, it is difficult to determine how much of the improvement resulted from differentiated instruction and how much of it occurred because of other reforms such as “the staff development focus on clarity about essential knowledge, understanding, and skills requirement for units and lessons.”⁴²

In addition, the rise in student test scores took place only one year after the principal began Conway’s differentiation initiative. Scores then declined slightly over the next two years.⁴³ Considering that differentiation was gradually introduced to the staff and not fully implemented by all teachers within the first year, it seems unlikely that it was the main factor behind the improved test scores.⁴⁴

Several years ago, the Alberta Initiative for School Improvement conducted a research study that was offered up in support of differentiated instruction.⁴⁵ However, this report is merely a qualitative description of the 25 most successful projects out of the more than 450 conducted during the research cycle. While the report summarizes the personal experiences of some of the study participants, it does not provide any good evidence for differentiated instruction’s effectiveness.

Thus, the evidence for the success of differentiated instruction is lacking. The evidence does not support the claims made by its advocates.

“**...even many advocates acknowledge that there is actually “no empirical validation of differentiated instruction as a package...**

How differentiated instruction undermines effective teaching

Since differentiated instruction is an unproven fad, it makes little sense to make it the focus of school reform. Fortunately, there is a path to improved student achievement that does not involve a significant amount of money or a complete overhaul of the structure of public education. Author and former school administrator Mike Schmoker outlines three research-based components that form the key to effective instruction.⁴⁶

- 1) A reasonably coherent curriculum;
- 2) Sound lessons; and,
- 3) Purposeful reading and writing in every course.

Far from being of minor importance, curriculum content is essential to a well-rounded education. As Willingham points out, students have only a limited amount of working memory. It is essential for them to have basic facts memorized, so they can handle more-advanced topics without having to look up information they should already know. This is particularly true in a subject such as math where a student who does not know the times table will forever struggle with multiplication and division questions.⁴⁷ Clearly, a properly structured, content-rich curriculum is important for student learning.

In addition, curriculum content is essential for reading comprehension. Students are most likely to understand an article if they know something about its topic. For example, a student who knows nothing about hockey is unlikely to comprehend an article describing last night's hockey game. Similarly, a person needs to know something about parliamentary democracy in order to understand an article about why a federal minority government fell on a vote of non-confidence. The evidence bears this out, as by the time children reach Grade 6, those in schools with a content-rich curriculum have significantly higher reading levels than do students in schools without this focus.⁴⁸

The second component is sound lessons. When Schmoker refers to sound lessons, he means that teachers need to be clear about their learning objectives, communicate the content effectively, lead students in guided practice and check regularly for student understanding.⁴⁹ This is also known as direct instruction, and research solidly supports its effectiveness.⁵⁰ Far from being a relic of the past, direct instruction, when done properly, remains an excellent way to help students learn.

As for purposeful reading and writing, Schmoker suggests this consists of "[c]lose reading/underlining and annotation of text, discussion of the text, and writing about the text informed by close reading, discussion, and annotation."⁵¹ In other words, students need to read and engage with challenging texts, including properly written textbooks. Instead of wasting their time with meaningless standards (such as "[i]dentify the main idea" and "[i]dentify the sequence of events"), students need to spend more time actually reading and writing.⁵²

The real harm of differentiated instruction comes from how it undermines each of these three essential components of effective teaching. As noted earlier, advocates of differentiated instruction downplay the importance of content and suggest that the process of learning is more important than what is learned. By making a content-rich

curriculum optional, differentiated instruction deprives students of the knowledge base they need to be successful learners.

In addition, differentiated instruction undermines teachers who wish to give sound lessons using direct instruction. When teachers are expected to teach multiple lessons on each topic and encouraged to let students work at learning centres of their own choosing, students lose the advantages of focused whole-class instruction. Constructivist teaching methods that encourage teachers to be a “guide on the side rather than a sage on the stage” make it harder for students to acquire important skills and knowledge.

Finally, by labelling students as visual, auditory or tactile-kinesthetic learners, differentiated instruction makes it easy for students to avoid doing regular close reading of complex text that would help them become better readers and writers. All students, regardless of their so-called learning style, need to spend focused time reading and writing. Differentiated instruction undermines this by encouraging students to concentrate only on activities or subjects that match their preferred style of learning.

Far from being a helpful reform, differentiated instruction can be downright harmful to students’ education.

“*The real harm of differentiated instruction comes from how it undermines each of these three essential components of effective teaching.*”

Conclusion

While advocates of differentiated instruction undoubtedly have good intentions, there is little proof of its effectiveness and many solid reasons to doubt whether it should be widely implemented. It does not make sense to expect teachers to identify the individual learning styles of each student when there is no evidence these styles even exist. Imposing constructivist teaching methods that rely heavily on student choice and interest is even more dubious and makes it difficult for teachers to provide the direct instruction that students need.

This does not mean that teachers should teach each class exactly the same way. In fact, it makes sense for teachers to use a variety of strategies to engage students in learning. It also makes sense for them to adjust their teaching style if they observe that students do not understand the material. There may even be times when a good teacher might use some of the methods recommended by differentiated instruction advocates. While differentiated instruction should not be the focus of schools, some of the ideas within it could be useful in moderation.

Unfortunately, the field of education has a well-deserved reputation for being too quick to adopt the latest fad. This should change. A careful examination of new initiatives such as differentiated instruction would be a good start. Instead of jumping wholesale into the latest fad, educators need to critically examine the claims made by proponents and decide for themselves what ideas are worthy of implementation. This can be done by a combination of examining the research evidence and considering what actually works in their experience.

“While differentiated instruction should not be the focus of schools, some of the ideas within it could be useful in moderation.”

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Further Reading

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Zero Support for No-zero Policies

By Michael Zwaagstra

http://www.fcpp.org/files/5/PS140_ZeroSupportID_AG20F1.pdf

September 2011

Math Instruction That makes Sense

By Michael Zwaagstra

http://www.fcpp.org/files/1/PS120_MathInstruct_SP15F1.pdf

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